Contrib. Astron. Obs. Skalnaté Pleso **43**, 228 – 228, (2014)

Enhancing performance of metre-class telescopes by using photonic devices

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Received: August 15, 2013; Accepted: January 17, 2014

Abstract. Over the last couple of years there has been increased interest in single-mode spectrographs, such as bulk optics-based single mode spectrographs and integrated photonic spectrographs. Such instruments have several key advantages over traditional (multi-moded) spectrographs: precision, small size, and related relatively low cost. However, the ground-based telescopes suffer from atmospheric distortions causing the light delivered by astronomical telescopes being multi-mode (seeing-limited) in nature. Current solutions to correct for atmospheric turbulence (such as adaptive optics) are inefficient in the visible wavelength range and very expensive. Therefore, we use an alternative solution and develop devices called *photonic lanterns* which convert a seeing-limited signal into multiple diffraction-limited spots and suit as a link between the telescope and a single-mode device.

By means of the ultrafast laser inscription, we fabricate photonic lanterns on a glass chip. We optimised the design in order to achieve high throughput and created robust, highly efficient devices, which can greatly enhance the efficiency and performance of the seeing-limited telescopes.